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ATTORNEYS AT LAW

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Re: Takashi NODA ET AL. - U.S. Patent Application
NETWORK INTERFACE APPARATUS FOR CONTROLLING
THE SIZE, COUPLING OR TRANSFER RATE OF PACKETS ON THE
BASIS OF AN IP NETWORK DELAY AND A METHOD THEREFOR

Sir:

Please find attached hereto a patent application which includes::

Specification, Claims, Declaration, Power of Attorney.

Formal Drawings: 5 sheets (Figs. 1-5)

Assignment + certified cover sheet and fee

Certified copy of Japan 11-351713 filed 12-10-99.

Information Disclosure Statement + PTO Form 1449 + copies of 5 pubs.

Fee (see formula below) Check Enclosed

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NETWORK INTERFACE APPARATUS FOR CONTROLLING THE SIZE,
COUPLING OR TRANSFER RATE OF PACKETS ON THE BASIS OF AN IP
NETWORK DELAY AND A METHOD THEREFOR

5 BACKGROUND OF THE INVENTION

Field of the Invention

 The present invention relates to a network interface
apparatus for use in data communication over an IP (Internet
Protocol) network and a method therefor. More particularly,
10 the present invention is advantageously applicable to a gateway
apparatus connected to a computer function for performing data
communication such as a real-time G3 facsimile connected to
the Internet for establishing smooth communication therebetween.

15 Description of the Background Art

 Several related technologies, described below, have been
proposed for data communication, communication control, and
connection selection for use in systems with different transfer
speeds or transmission rates.

20 First, in Japanese Patent Laid-Open Publication No.
96454/1992, there is disclosed a communication control system
for adjusting transfer speeds for data communication between
systems with different transfer speeds. This publication
25 describes a system in which transfer speed conversion means
is provided between two systems for controlling data transfer
processing via control means. This system uses only one dual-
port RAM, instead of a buffer memory such as a FIFO memory,
to reduce the system cost.

30 Second, in Japanese Patent Laid-Open Publication No.
331164/1996, there is disclosed a communication control system
for use in connecting to a plurality of types of LANs. This
system has a buffer controller that sets up a buffer size at
35 the start of data transfer processing. This buffer size defines

the maximum data amount processible by one transmission/reception sequence according to the environment condition to increase data transfer efficiency.

5 Third, in Japanese Patent Laid-Open Publication No. 331348/1997, there is disclosed a network connection apparatus that selects destinations according to the protocol type. This apparatus has a pre-set table, via which a line best suited for the protocol of a received packet is selected for
10 transmission, to increase user operability and reduce line costs.

In addition, in Japanese Patent Laid-Open Publication No. 178494/1998, there is disclosed a communication terminal,
15 a communication system, and a communication control method. For example, when the continuous communication time is limited to a predetermined period of time as in the G3 protocol, the maximum data amount that can be sent is set by setting means based on the limitation time and the amount of transmission
20 data. Control means of the system controls transmission based on this setting to send data smoothly.

Finally, in Japanese Patent Laid-Open Publication No. 334023/1998, there is disclosed electronic equipment that can
25 be applied to network communication according to the TCP/IP (Transmission Control Protocol/Internet Protocol) protocol. When the equipment receives print output data from an upline network, it notifies a terminal or some terminals on a downline network, to which the equipment is connected, that the data
30 has been received. And, upon receiving a data request from the terminal in response to this notification, the equipment sends the received data to the terminal. This method allows the user of a terminal on the downline network to recognize that the data has been received on the upline network and,

therefore, utilizes the functions of the TCP/IP network.

Today, real-time Group 3 facsimile (hereinafter called a real-time G3FAX) communication is performed based on the ITU-T (International Telecommunication Union-Telecommunication Standardization Sector) Recommendations T.30 and T.38. For reliable data transmission, one of two protocols is used: Transmission Control Protocol (hereinafter called TCP) for an Internet Protocol (herein after called IP) network and User Data Protocol (hereinafter called UDP) for an IP network.

The Recommendation T.30 proposes a real-time G3FAX protocol for providing good quality image transmission. To make adjustment of processing between a gateway and a real-time G3 terminal and to reduce a transfer delay, the Recommendation T.38 specifies how to make adjustment of image transmission within the specifications of the Recommendation T.30 and according to the (TCP/UDP) service environment.

Facsimile control data and image data in accordance of the Recommendation T.30 are transmitted in IFP (Internet Facsimile Protocol) packets, corresponding to the payload of the data area and each with an octet stream structure, using one of the protocols described above.

In an actual operation, a real-time G3FAX defines an operation setting according to the protocol, performs negotiations, and determines the transfer speed of data such as image data. However, because the data transfer speed is determined with no consideration for the IP network conditions, the determined real-time G3FAX transfer speed is not attained during TCP communication if the IP network transmission delay is large. When this condition occurs, the real-time G3FAX, for example, judges that an error occurred during communication

between the real-time G3FAX and the IP network and terminates processing abnormally.

SUMMARY OF THE INVENTION

5 The present invention seeks to solve the problems associated with the prior art described above. It is therefore an object of the present invention to provide a network interface apparatus and a method therefor that can, in consideration of transmission to or from the IP network, avoid
10 an abnormal termination of a real-time G3FAX transmission.

 To solve the above problems, a network interface apparatus for interfacing a communication terminal with an IP network comprises an adjuster operative in response to information
15 supplied from the IP network and/or on a difference in an amount of data sent between the IP network and the communication terminal for adjusting a packet size of data, a transfer speed of supplied data according to the information from the IP network, or the data amount to be sent at a time.

20 It is preferable that the adjuster comprises a size controller controlling the packet size according to the information from the IP network when the supplied data is divided into units each having a predetermined amount.

25 It is preferable that the adjuster comprises a transfer speed controller for controlling the data transfer speed at which the supplied data is transferred to or from the communication terminal according to the information obtained
30 from the IP network.

 It is advantageous that the adjuster comprises a memory in which an amount of data corresponding to the difference in the amount of data sent between the IP network and the

communication terminal is coupled and stored; and an input/output control for controlling an input/output of the memory according to whether or not the amount of data produced by a packetizer circuit and the amount of data stored in the memory are equal to or larger than a predetermined amount.

The interface apparatus may advantageously be included in a record transmission apparatus for capturing an image of a document to from data representative of the image.

The network interface apparatus according to the present invention determines the delay in transmission between the IP network and the apparatus as delay information at an interface circuit. The control circuit operates in response to the delay information for controlling a packetizer circuit to adjust the size of a packet on the basis of the delay information. The control circuit controls a transmitter to adjust the transfer rate of transferring the data on the basis of the delay information. The packetizer circuit sends the packetized data to a packet coupler. The packet coupler stores and couples the supplied packets with each other. The packet coupler inhibits the packetizer circuit from developing the packet, when the packet coupler stores more packets than a first predetermined amount. The network interface apparatus satisfactorily adjusts the negotiation between the IP network and the communication terminal, such as the FAX terminal, for performing data communication in real time.

To solve the above problems, in first, a method of interfacing a communication terminal with an IP network according to the present invention comprises the steps of, receiving data to be transferred from the communication terminal; determining a delay in transmission over the IP network; packetizing the data to be transferred into a packet;

adjusting the size of the packet on the basis of the delay determined; and transferring the packet having the size adjusted to the IP network.

5 To solve the above problems, in second, a method of interfacing a communication terminal with an IP network according to the present invention comprises the steps of, receiving data to be transferred from the communication terminal; determining a delay in transmission over the IP
10 network; packetizing the data to be transferred into a packet; adjusting the transfer rate of transferring the data on the basis of the delay determined; and transferring the data to the IP network.

15 To solve the above problems, in third, a method of interfacing a communication terminal with an IP network according to the present invention comprises the steps of, receiving data to be transferred from the communication terminal; determining a delay in transmission over the IP
20 network; packetizing the data to be transferred into a packet by a packetizer circuit; coupling two or more of the packets with by a packet coupler; transferring the packet to the IP network; and inhibiting the packetizer circuit from developing the packet when the packet coupler includes more packets than
25 a predetermined amount.

 The method of interfacing a communication terminal with an IP network according to the present invention determines a delay in transmission over the IP network, when receiving
30 data transferred from the communication terminal. The method adjusts the size of the packet or the transfer rate of transferring the data on the basis of the delay. A packetizer circuit packetizes data to be transferred into a packet. A packet coupler stores the packets and couples two or more of

the packets. The packetizer circuit is inhibited from developing the packet when the packet coupler includes more packets than a predetermined amount. Thus, the method adjusts the packetizing of data to be transferred to the IP network.

5 In these way, the method adjusts the delay encountered during communication between the IP network and the communication terminals to prevent an abnormal termination.

BRIEF DESCRIPTION OF THE DRAWINGS

10 The objects and features of the present invention will become more apparent from consideration of the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a block diagram schematically showing an embodiment of a FAX adapter to which a communication connection apparatus according to the present invention is applied;

15

FIG. 2 is a schematic block diagram, similar to FIG. 1, showing an alternative embodiment of the invention;

FIG. 3 is a schematic block diagram, also similar to FIG. 1, showing a further alternative embodiment of the invention;

20

FIG. 4 is a flowchart useful for understanding the IFP coupling operation that is performed for IFP packets sent from the IFP packetizer shown in FIG. 3; and

FIG. 5 is a block diagram schematically showing an embodiment of an integrated real-time FAX which includes the alternative embodiment shown in FIG. 2 and a built-in G3FAX.

25

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of a communication connection apparatus according to the present invention will be described in detail with reference to the accompanying drawings.

30

Briefly, in the illustrative embodiments, the communication connection apparatus according to the present invention

comprises an adjuster which adjusts a data transmission and reception delay involved in the transfer of data between the IP network and a communication apparatus. The adjuster does so by changing the packet size according to the information from the IP network or according to the storage amount of data sent from a communication apparatus or by changing the transfer speed according to the information (for example, delay information) sent from the IP network. In this way, the communication connection apparatus according to the present invention adjusts the negotiation between a communication apparatus included the IP network and so on to transfer data in real time.

The communication connection apparatus applied to a FAX adapter 10 will be described. The components not directly related to the present invention are not included in the figures nor the description. A signal is referred to by the reference number of the connection line over which the signal is sent.

Referring to FIG. 1, the FAX adapter 10 is provided between a Group 3 facsimile (hereinafter called G3FAX) 20 and an IP (Internet Protocol) network 30 over which data is transmitted according to the IP. The destination terminal (for example, a computer) at the other end of communication over the IP network 30 is omitted in the figure. The FAX adapter 10 corresponds to a gateway. The G3FAX 20 is a sort of communication terminal adapted to capture an image of an original document to form data representative of the image, which will in turn be developed on its output port 12d.

The FAX adapter 10 basically comprises a network interface 10a, a receiver 10b, a G3FAX signal processor 10c, a transmitter 10d, and a packet size controller 10e. Basically, the network interface 10a interfaces the physical/electrical characteristics

of signals sent via other nodes so that they are interconnected successfully and performs data link and protocol processing. The network interface 10a sends a TCP packet 12a received from the IP network 30 to the receiver 10b.

5

Though not shown in the figure, the network interface 10a of this embodiment includes a ping (one of utility programs) transmission section and a delay time measuring section, both not shown. Ping is a command used to confirm that a computer has established a correct and complete connection with another computer at the IP level. In practice, ping uses the Internet Control Message Protocol (ICMP). When ping is executed, an echo request is sent to the terminal equipment at the other end of the connection to check its status. Upon receiving this request, the terminal equipment at the other end sends an echo back. The time the echo request is sent or received is sent from the timer of the FAX adapter 10 to the delay time measuring section.

20 The delay time measuring section subtracts the transmission time from the reception time to calculate the difference. This time difference is a communication response time. The network interface 10a sends this information 12f to the packet size controller 10e, which will be described later, as the delay information (i.e., time difference). When no response is received for a predetermined period of time after ping is sent, the ping transmission section sends another ping.

30 The receiver 10b comprises a TCP/IP receiver 100b and an IFP packet analyzer 102b. Either the IFP/TCP/IP packet hierarchy model indicating the high-level IFP/TCP/IP packet structure or the flat model is applied to the TCP/IP receiver 100b. The TCP/IP receiver 100b obtains an IFP packet area according to these models. More specifically, when the model

is the hierarchy model, the TCP payload in the IP payload corresponds to an IP packet. When the model is the flat model, an IFP packet is directly below the TCP header. The obtained IFP packet 12b is sent to the IFP packet analyzer 102b. The
5 IFP packet 12b includes one or more HDLC (High level Data Link Control) frames or phase C data "pages".

The IFP packet analyzer 102b analyzes the type included in the received IFP packet 12b and the setting of the type
10 field and depacketizes the packet 12b into a series of data. The analysis of the IFP packet contents gives an instruction indicating how to communicate with the G3FAX 20. This instruction is represented by an IFP data element which includes the ITU-T Recommendation T.30 indicator value, T.30 data type,
15 data from the connected PSTN (Public Switched Telephone Network), and other data format indicators. The IFP data element is composed of one or more fields, each field being composed of the field part and the field-data part. An IFP packet is analyzed according to this definition. The analysis
20 result is sent to the G3FAX signal processor 10c as FAX data 12c.

The G3FAX signal processor 10c converts the FAX data 12c to G3FAX 20 signals based on the analysis result. More
25 specifically, the G3FAX signal processor 10c generates the G3FAX-based modulated FAX signal according to the instruction indicating how to modulate FAX data 12c. The G3FAX signal processor 10c outputs a generated FAX signal 12d to the G3FAX 20. The G3FAX signal processor 10c also generates transmission
30 data that will be described later.

The G3FAX 20 processes the FAX signal 12d in the same manner (demodulation) as the FAX signal received on a PSTN line and outputs it, for example, on paper. In this manner,

the FAX signal is received and displayed.

Conversely, when data read from the G3FAX 20 is sent, the G3FAX 20 modulates the data based on the G3FAX standard. The modulated G3FAX signal is sent to the G3FAX signal processor 10c of the FAX adapter 10. The G3FAX signal processor 10c converts the FAX signal 12d received from the G3FAX 20 to digital data, that is, to FAX data 12e. This conversion is performed with no consideration for the conditions of the IP network 30. The FAX data 12e is sent to the transmitter 10d.

The transmitter 10d comprises a packet size data storage 100d, an IFP packetizer 102d, and a TCP/IP transmitter 104d. The packet size data storage 100d stores therein condition data indicating how the transmitter 10d sets up FAX data based on the T.38 standard. The FAX data is sent to the IFP packetizer 102d under the control of the system controller which is not shown in the figure. At this time, the IFP packetizer 102d packetizes the FAX data 12e on the basis of the IFP protocol satisfying the specified condition. The FAX data 12e is packetized so that it may be stored in the payload. The IFP packetizer 102d sends the IFP packet 12g to the TCP/IP transmitter 104d.

The TCP/IP transmitter 104d incorporates the IP header and the TCP header into the IFP packet 12g according to the model and outputs the TCP packet 12h to the network interface 10a. The network interface 10a interfaces the physical/electrical characteristics of the TCP packet 12h and then outputs the packet 12h to the IP network 30.

However, depending upon the conditions of the IP network 30, the negotiation with the other end of the connection, such as a communication terminal or a G3FAX, could otherwise not

be performed properly as described above. To solve this problem, the packet size controller 10e is provided in this embodiment. The packet size controller 10e controls the packet size data storage 100d (packet size adjustment process of data) based on the information (delay information) 12f sent from the network interface 10a.

Several types of size data are pre-stored in the packet size data storage 100d. In response to control data 14 from the packet size controller 10e, the packet size data storage 100d outputs an instruction to the IFP packetizer 102d. The IFP packetizer 102d packetizes the data with the size according to the instruction and sends the generated packet to the other end equipment of the connection via the TCP/IP transmitter 104d, network interface 10a, and the IP network 30.

In other words, the TCP packet size may be changed in real time considering the conditions of the IP network 30. For example, when the delay is large, the packet size is increased. This increases TCP transfer efficiency and satisfies the transfer speed or transmission rate requirements determined by the G3FAX protocol. That is, the negotiation is performed reliably and therefore the abnormal termination of real time G3FAX communication may be avoided.

Next, an alternative embodiment of the FAX adapter 10 will be described with reference to FIG. 2. In this embodiment, the network interface 10a, receiver 10b, G3FAX signal processor 10c, and transmitter 10d are the same as those in the above embodiment shown in and described with reference to FIG. 1. The description of the same components are not repeated. In the alternative embodiment, the delay information sent to the packet size controller 10e in the above embodiment is sent to a transfer speed converter 10f. As shown in FIG. 2, the

transfer speed converter 10f is provided between the G3FAX signal processor 10c and on one hand the receiver 10b and on the other hand the transmitter 10d.

5 This arrangement allows the transfer speed converter 10f to receive the FAX data 12c from the receiver 10b when receiving and to receive the FAX data 12e from the G3FAX signal processor 10c when transmitting. The transfer speed converter 10f modifies the facsimile control field data of the FAX data 12c and 12e, sent based on the T.30 standard, according to the
10 delay information 12f.

 More specifically, the delay information 12f, which indicates the difference between the communication speed of
15 the IP network 30 and the transfer speed, is sent to the transfer speed converter 10f. Upon receiving this data, the transfer speed converter 10f changes the transfer speed data on the FAX data 12c and 12e according to the received delay information 12f so that the transfer speed does not exceed
20 the communication speed of the IP network 30. Note that, because data is received at a speed determined by the communication speed of the IP network 30 during data reception, the data speed need not be changed at reception. Therefore, the transfer speed converter 10f may be designed to output
25 received data without changing the speed.

 On the other hand, the digital identification signal (DIS/DTC, hereinafter called DIS) is changed during data transmission. The DIS signal represents the standard ITU-T
30 capability of the called unit. The digital command signal (hereinafter called DCS) is also available as a reference. The DCS signal is a digital setting command that responds to the standardized function identified by the DIS signal.

The DIS signal and the DCS signal, both of which correspond to bits 11-14 of the facsimile data control field, represent the data signal speed. More specifically, the DIS signal uses these bits to represent the standard used. When the bits are "0000", the V.27ter fallback mode is selected; when the bits are "0100", V.27ter is selected; when the bits are "1000", V.29 is selected; when the bits are "1100", V.27ter or V.29 is selected according to the delay information 12f; when the bits are "1101", V.27ter, V.29, or V.17 is selected according to the delay information 12f. The transfer speed is changed based on the delay information 12f so that the preset communication speed of the IP network 30 are satisfied when transmitting.

15 The DCS signal uses these bits to represent the data signal speed and the standard used. When the bits are "0000", 2400 bits/s of V.27ter is used; when the bits are "0100", 4800 bits/s of V.27ter is used; when the bits are "1000", 9600 bits/s of V.29 is used; when the bits are "1100", 7200 bits/s of V.29 is used; when the bits are "0001", 14400 bits/s of V.17 is used; when the bits are "0101", 12000 bits/s of V.17 is used; when the bits are "1001", 9600 bits/s of V.17 is used; when the bits are "1101", 7200 bits/s of V.17 is used. These bits indicate the setting of FAX data 12c that is received during reception.

25 The transfer speed converter 10f converts the transfer speed according to the conditions of the IP network 30 and the conditions of the G3FAX 20. Especially when the conditions of the IP network 30 must be considered, the converter 10f changes the signal bit data described above so that the requirements are satisfied, taking into consideration the delay information 12f representing the conditions of the network to which the terminal equipment at the other end is connected.

This is done under the control of the system controller which is not shown in the figure. During reception, the transfer speed converter 10f does not process the received data but outputs a FAX signal 12i directly to the G3FAX signal processor 10c. During transmission, the transfer speed converter 10f outputs a speed-adjusted FAX signal 12j to the IFP packetizer 102d. This conversion also may successfully adjust the speed so that the transfer rate does not exceed the TCP/IP communication capability so that a communication abnormal termination is avoided.

The operation procedure of the transfer speed converter 10f will be described briefly. When the DIS signal of the FAX data is detected, the transfer speed converter 10f modifies the DIS signal bit data based on the Recommendation T.30 to maximize the FAX transmission speed within the allowable transmission speed range. In other cases, the transfer speed converter does nothing but outputs the FAX data.

Next, a further alternative embodiment of the FAX adapter 10 will be described with reference to FIG. 3. In this embodiment, the network interface 10a, receiver 10b, and G3FAX signal processor 10c are the same as those in the first embodiment described above. The description of the same components are not repeated. In the instant, alternative embodiment, an IFP coupler 108d is added to the transmitter 10d in the first embodiment described above. In this embodiment, when there is a difference in speed between the generation of the IFP packet 12g from the IFP packetizer 102d and an output 12l from the IFP coupler 108d, it is assumed that this difference may be considered as a delay caused by the conditions of the G3FAX 20 and the IP network 30, for example, by the congestion in the IP network 30. Because this difference is reflected on the amount of IFP packets stored

in the packet coupling work memory, not shown, in the IFP coupler 108d, the memory size is designed considering this difference. This means that the packet coupling work memory may have the adjustment function used to reduce the difference
5 considered as a delaying situation so as to maintain a connection relation with the other end equipment of the connection.

To implement this adjustment function, the IFP coupler
10 108d includes a work memory controller which is not shown in the figure. When the work memory contains more IFP packets 12g than a predetermined amount, the work memory controller outputs a control signal 12k to the IFP packetizer 102d to inhibit packet transmission. Conversely, when the work memory
15 contains less IFP packets 12g than the predetermined amount, the work memory controller outputs the control signal 12k to the IFP packetizer 102d to request packet transmission.

The operation of the IFP coupler 108d will be described
20 briefly with reference to FIG. 4. The IFP coupler 108d checks if packets are supplied and the coupler 108d is in the receiving state. If no IFP packet is supplied (NO) at step S10, the coupler 108d waits for IFP packets to be supplied. When packets are supplied and the coupler 108d enters the receiving state
25 (YES), the coupler 108d couples the received packets together in the work memory (step S12). The coupler 108d checks if there is more receiving data and more IFP packets are to be supplied (step S14). If there is more receiving data (YES), the coupler 108d checks if the IFP work memory includes data
30 exceeding the predetermined amount (or area) (step S16).

If, as the result of checking, the storage area of the memory used for coupling IFP packets has exceeded the predetermined amount (YES), the coupler 108d inhibits the

reception of IFP packets (step S18). To do so, the work memory controller outputs the control signal 12k as described above. IFP packets are sent to the TCP/IP transmitter 104d while the reception of IFP packets is inhibited (step S20). If the memory
5 has not yet contained data exceeding the predetermined amount (NO), the coupler 108d requests the IFP packetizer 102d to send IFP packets (step S22). To do so, the work memory controller outputs the control signal 12k to the IFP packetizer 102d. The supplied IFP packets are coupled in the IFP coupler
10 108d (step S24). After steps S20 and S24, the control returns to step S14 to check if there is receiving data.

If, as the result of checking, there is no more receiving data (NO), the coupler 108d judges that there is no more data
15 for generating IFP packets. The IFP coupler 108d then checks if there are IFP packets in the work memory (step S26). If there are coupled IFP packets or non-coupled IFP packets in the work memory area (YES), the IFP coupler 108d sends all remaining IFP packets to the TCP/IP transmitter 104d (step
20 S28). If there is no data in the work memory (NO), the coupler 108d judges that all supplied FAX data has been converted to IFP packets and that those IFP packets have been transferred. After that, the coupler 108d checks if the power is turned off (step S30). If the power is turned off (YES), the coupler
25 108d terminates the sequence of processing. If the power is not turned off (NO), the coupler 108d returns control to step S10 and waits for IFP packets.

This configuration enables the FAX adapter 10 to
30 sequentially couple and store IFP packets received from the IFP packetizer 102d and to send the coupled IFP packets to the TCP/IP transmitter 104d. This capability allows the TCP/IFP packet size to be increased when the delay of the IP network
30 is large and the TCP/IFP packets transfer efficiency is

bad. Therefore, an abnormal termination, which would be caused when the transfer speed determined by the G3FAX protocol conforming to the Recommendation T.30 standard is not satisfied, may be avoided.

5

The FAX adapter 10 has been described as an adapter to be connected to the G3FAX 20. It is also possible that the FAX adapter 10 is built into the G3FAX 20 to form a real-time FAX 40. As shown in FIG. 5, the real-time FAX 40 has a G3FAX 10g in addition to the network interface 10a, receiver 10b, transmitter 10d which are the same components as those described above.

The G3FAX 10g comprises the transfer speed converter 10f, G3FAX signal processor 10c, and G3FAX 20 shown in FIG. 3. The delay information 12f is sent from the network interface 10a to the G3FAX 10g. This integrated real-time FAX 40 allows reliable facsimile communication to be performed in real time while still avoiding an abnormal termination such as the one described above.

Even if the G3FAX protocol requirements are not satisfied because of a delay and so on during communication with the other end equipment of connection via the FAX adapter 10 connecting the G3FAX 20 and the IP network 30, the above configuration resolves a discrepancy between the actual speed and the setting to prevent an abnormal termination that would occur in the conventional facsimile. The discrepancy is resolved by adaptively changing the packet size according to the delay information, by adaptively changing the transfer speed according to the information from the IP network, or by coupling packets. Therefore, the present invention enables a real time FAX to transmit data more reliably.

The entire disclosure of Japanese patent application No. 351713/1999 filed on December 10, 1999 including the specification, claims, accompanying drawings and abstract of the disclosure is incorporated herein by reference in its entirety.

While the present invention has been described with reference to the particular illustrative embodiments, it is not to be restricted by those embodiments. It is to be appreciated that those skilled in the art can change or modify the embodiments without departing from the scope and spirit of the present invention.

WHAT IS CLAIMED IS:

1. A network interface apparatus for connecting a communication terminal to an IP (Internet Protocol) network, comprising:

- 5 an input circuit for receiving data to be transferred from the communication terminal;
- a transmitter for transferring a packet to the IP network;
- an interface circuit for interfacing said transmitter with the IP network, and for determining a delay in transmission between the IP network and said apparatus to produce delay
- 10 information;
- a packetizer circuit for packetizing the data to be transferred into the packet; and
- a control circuit operative in response to the delay information for controlling said packetizer circuit to adjust
- 15 a size of the packet on a basis of the delay information.

2. An apparatus in accordance with claim 1, wherein said control circuit comprises a memory circuit for storing therein packet size data representative of packet sizes, and for developing packet size data associated with the delay

5 information, said packetizer circuit adjusting the size of the packet in response to the packet size data developed from said memory circuit.

3. An apparatus in accordance with claim 1, further comprising:

a receiver for receiving a packet transmitted over the IP network; and

- 5 an output circuit for depacketizing the packet into data and outputting the data to the communication terminal.

4. A network interface apparatus for connecting a communication terminal to an IP (Internet Protocol) network,

comprising:

an input circuit for receiving data to be transferred
5 from the communication terminal;

a transmitter for transferring the data to the IP network;

an interface circuit for interfacing said transmitter
with the IP network, and for determining a delay in transmission
between the IP network and said apparatus to produce delay
10 information; and

a control circuit interconnected between said input circuit
and said transmitter and operative in response to the delay
information for controlling said transmitter to adjust a
transfer rate of transferring the data on a basis of the delay
15 information.

5. An apparatus in accordance with claim 4, further
comprising:

a receiver for receiving data transmitted over the IP
network; and

an output circuit for outputting the transmitted data
to the communication terminal;

said control circuit being further interconnected between
said receiver and said output circuit and controlling said
output circuit to adjust a transfer rate of outputting the
transmitted data on a basis of the delay information.
10

6. An apparatus in accordance with claim 4, further
comprising a packetizer circuit for packetizing the data to
be transferred into a packet,

said transmitter transferring the data in a form of packet,

said control circuit being operative in response to
the delay information to control said transmitter to adjust
a transfer rate of transferring the packet.
5

7. An apparatus in accordance with claim 6, further

comprising:

a receiver for receiving a packet transmitted over the IP network; and

- 5 an output circuit for depacketizing the packet into data and outputting the data to the communication terminal;
said control circuit controlling said output circuit to adjust a transfer rate of outputting the data on the basis of the delay information.

8. A network interface apparatus for connecting a communication terminal to an IP (Internet Protocol) network, comprising:

- an input circuit for receiving data to be transferred
5 from the communication terminal;
a transmitter for transferring a packet to the IP network;
an interface circuit for interfacing said transmitter with the IP network;
10 a packetizer circuit for packetizing the data to be transferred into a packet to develop the packet;
a packet coupler for coupling two or more of the packets with each other; and
said packet coupler inhibiting said packetizer circuit
15 from developing the packet when said packet coupler includes more packets than a first predetermined amount.

9. An apparatus in accordance with claim 8, further comprising a control circuit for controlling said packet coupler to couple more packets when said packetizer circuit includes more data to be packetized.

10. An apparatus in accordance with claim 8, wherein said interface circuit determines a delay in transmission between the IP network and said apparatus to produce delay

information;

- 5 said apparatus further comprising a control circuit operative in response to the delay information for controlling said packetizer circuit to adjust a size of the packet on a basis of the delay information.

11. An apparatus in accordance with claim 8, wherein said packet coupler comprises:

a memory circuit for storing the coupled packets therein; and

- 5 a memory control circuit operative in response to said packetizing circuit and said memory circuit for controlling writing and reading of said memory circuit on a basis of whether or not said packetizer circuit includes more data to be packetized than the first
10 predetermined amount and of whether or not said memory circuit includes more packets than a second predetermined amount.

12. An apparatus in accordance with claim 10, further comprising:

a receiver for receiving a packet transmitted over the IP network; and

- 5 an output circuit for depacketizing the packet into data and outputting the data to the communication terminal; and

- said control circuit controlling said output circuit to adjust a transfer rate of outputting the data on the
10 basis of the delay information.

13. A communication apparatus for transferring data to an IP (Internet Protocol) network, comprising:

an input circuit for capturing an image of a document and forming data to be transferred representing the image;

5 a transmitter for transferring a packet to the IP network;
an interface circuit for interfacing said transmitter with the IP network, and for determining a delay in transmission between the IP network and said apparatus
10 to produce delay information;
a packetizer circuit for packetizing the data to be transferred into the packet; and
a control circuit operative in response to the delay information for controlling said packetizer circuit to
15 adjust a size of the packet on a basis of the delay information.

14. A communication apparatus for transferring data to an IP (Internet Protocol) network, comprising:
an input circuit for capturing an image of a document and forming data to be transferred representing the image;
5 a transmitter for transferring the data to the IP network;
an interface circuit for interfacing said transmitter with the IP network, and for determining a delay in transmission between the IP network and said apparatus
10 to produce delay information; and
a control circuit interconnected between said input circuit and said transmitter and operative in response to the delay information for controlling said transmitter to adjust a transfer rate of transferring the data on a
15 basis of the delay information.

15. A communication apparatus for transferring data to an IP (Internet Protocol) network, comprising:
an input circuit for capturing an image of a document and forming data to be transferred representing the image;
5 a transmitter for transferring a packet to the IP

network;

an interface circuit for interfacing said transmitter with the IP network;

10 a packetizer circuit for packetizing the data to be transferred into a packet to develop the packet;

a packet coupler for coupling two or more of the packets with each other; and

15 said packet coupler inhibiting said packetizer circuit from developing the packet when said packet coupler includes more packets than a first predetermined amount.

16. A method of interfacing a communication terminal with an IP (Internet Protocol) network, comprising the steps of:

5 receiving data to be transferred from the communication terminal;

determining a delay in transmission over the IP network;

10 packetizing the data to be transferred into a packet; adjusting a size of the packet on a basis of the delay determined; and

transferring the packet having the size adjusted to the IP network.

17. A method of interfacing a communication terminal with an IP (Internet Protocol) network, comprising the steps of:

5 receiving data to be transferred from a communication terminal;

determining a delay in transmission over the IP network;

10 adjusting a transfer rate of transferring the data on a basis of the delay determined; and transferring the data to the IP network.

18. A method of interfacing a communication terminal with an IP (Internet Protocol) network, comprising the steps of:

- 5 receiving data to be transferred from the communication terminal;
- packetizing the data to be transferred into a packet by a packetizer circuit;
- coupling two or more of the packets with each other by a packet coupler;
- 10 transferring the packet to the IP network; and
- inhibiting the packetizer circuit from developing the packet when the packet coupler includes more packets than a predetermined amount.

19. A storage medium for storing therein a procedure of interfacing a communication terminal with an IP (Internet Protocol) network, comprising the steps of:

- 5 receiving data to be transferred from the communication terminal;
- determining a delay in transmission over the IP network;
- packetizing the data to be transferred into a packet;
- adjusting a size of the packet on a basis of the delay
- 10 determined; and
- transferring the packet having the size adjusted to the IP network.

20. A storage medium for storing therein a procedure of interfacing a communication terminal with an IP (Internet Protocol) network, comprising the steps of:

- 5 receiving data to be transferred from a communication terminal;
- determining a delay in transmission over the IP

network;

adjusting a transfer rate of transferring the data
on a basis of the delay determined; and

10 transferring the data to the IP network.

21. A storage medium for storing therein a procedure
of interfacing a communication terminal with an IP
(Internet Protocol) network, comprising the steps of:

5 receiving data to be transferred from the
communication terminal;

packetizing the data to be transferred into a packet
by a packetizer circuit;

coupling two or more of the packets with each other
by a packet coupler;

10 transferring the packet to the IP network; and

inhibiting the packetizer circuit from developing
the packet when the packet coupler includes more packets
than a predetermined amount.

ABSTRACT OF THE DISCLOSURE

During G3FAX communication with an IP network 30,
a FAX adapter 10 controls a packet size data storage
100d with the use of a control signal 14, generated by
5 a packet size controller 10e, to adjust the packet size
of FAX data sent from a G3FAX 20 according to delay
information 12f from the IP network 30. When sending
data to the IP network 30, the adapter 10 allows the
size of a packet to be adjusted in response to the delay
10 information 12f sent from the IP network 30, thus
resolving a discrepancy in transfer speed.

Fig. 1

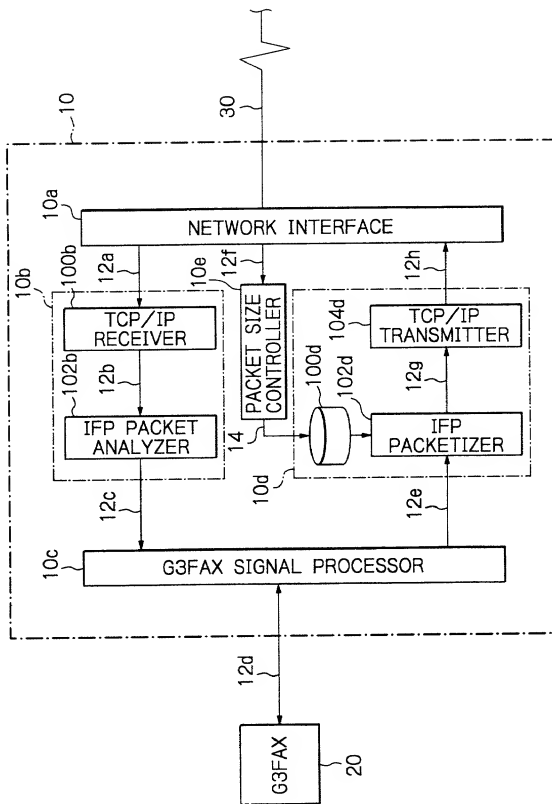


Fig. 2

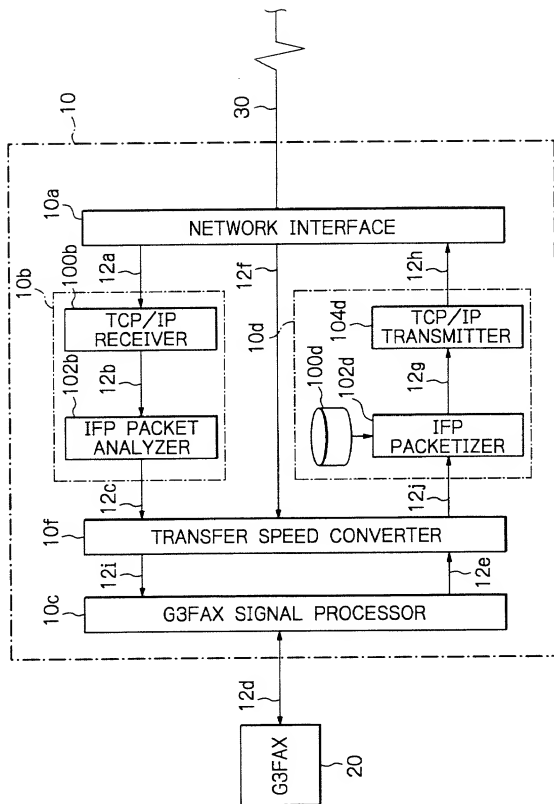


Fig. 3

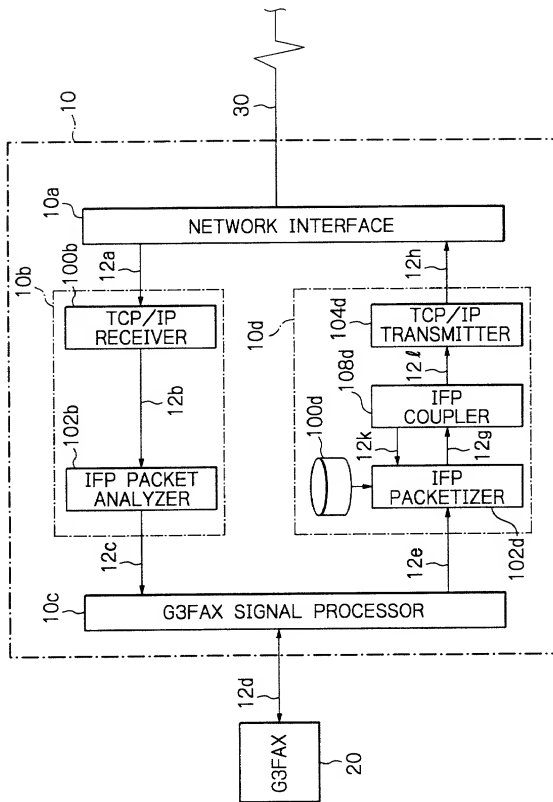


Fig. 4

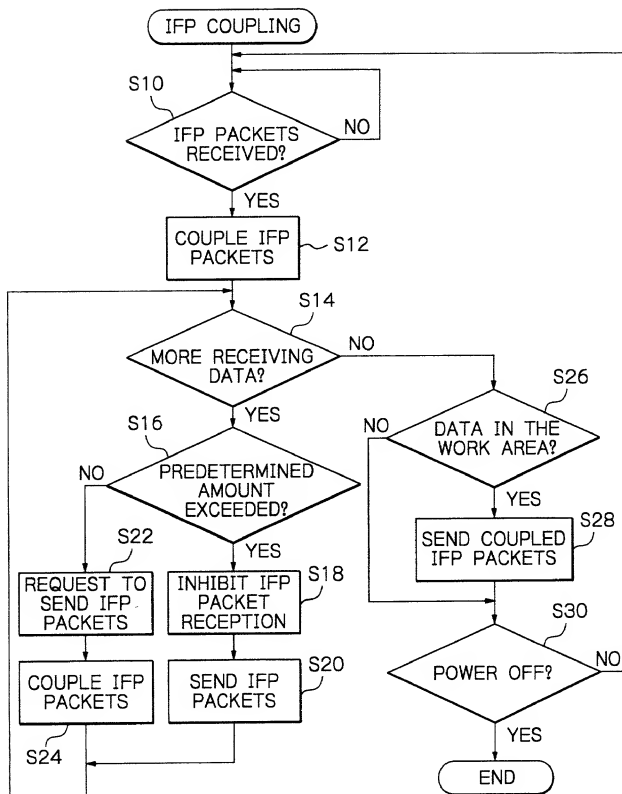
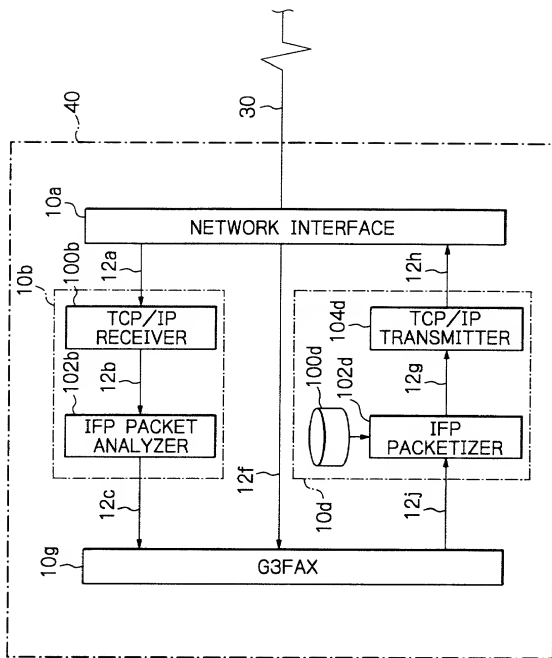


Fig. 5



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Declaration and Power of Attorney For Patent Application

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NETWORK INTERFACE APPARATUS FOR CONTROLLING THE SIZE, COUPLING OR TRANSFER RATE OF PACKETS ON THE BASIS OF AN IP NETWORK DELAY AND A METHOD THEREFOR

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_____ and was amended on
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Prior Foreign Application(s)

外国での先行出願

351713/1999

(Number)
(番号)

JAPAN

(Country)
(国名)(Number)
(番号)(Country)
(国名)

I hereby claim foreign priority under Title 35, United States Code, Section 119 (a)-(d) or 365 (b) of any foreign application(s) for patent or inventor's certificate, or 365 (a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, b checking the box, any foreign application for patent of inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Priority Not Claimed

優先権主張なし

December 10, 1999

(Day/Month/Year Filed)
(出願年月日)☐(Day/Month/Year Filed)
(出願年月日)☐

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(出願番号)(Filing Date)
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(出願番号)(Filing Date)
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